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# (54) Security device

(57) The device for detecting security strips in thin transparent or translucent sheets comprises an enclosed scanning chamber (1) adapted to allow the passage of a bank note or similar security (12). The note passes between one or more rows of infra-red radiation sources (10) and matching rows of associated infra-red radiation detectors (11) spaced from the radiation sources within the scanning chamber. The output signal from each detector depends upon the presence or absence of an infra-red opaque object. Logic means is arranged to receive the output signals from each row of detectors and provides a strip detection signal if half or more of the signals in a row are substantially reduced. The strip detection signal initiates an output signal such as an audible warning and/or illumination of an indicator light. The logic output from each row may be fed to a latching circuit with a limited latch duration. Simultaneous latching of the latching circuits is detected and used to operate the output signal and to reset the latch circuits. The device is responsive to the width of the security strip.

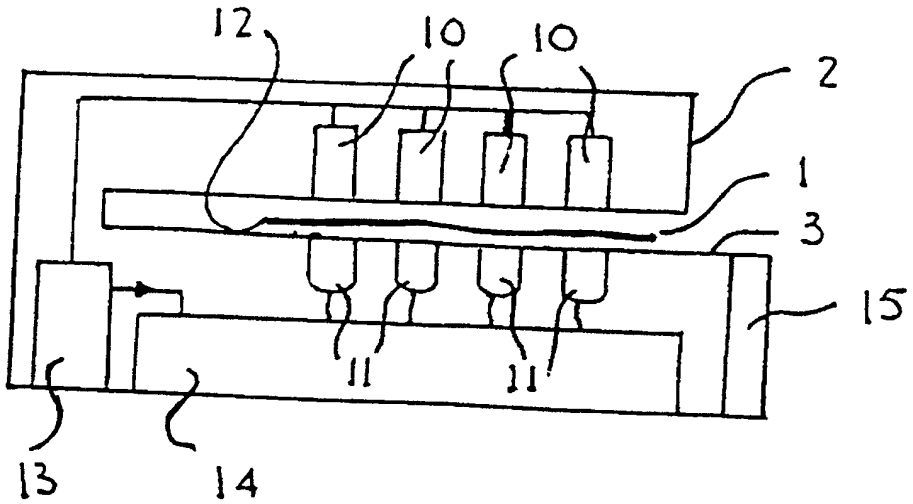


FIG 2

GB 2 273 353 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

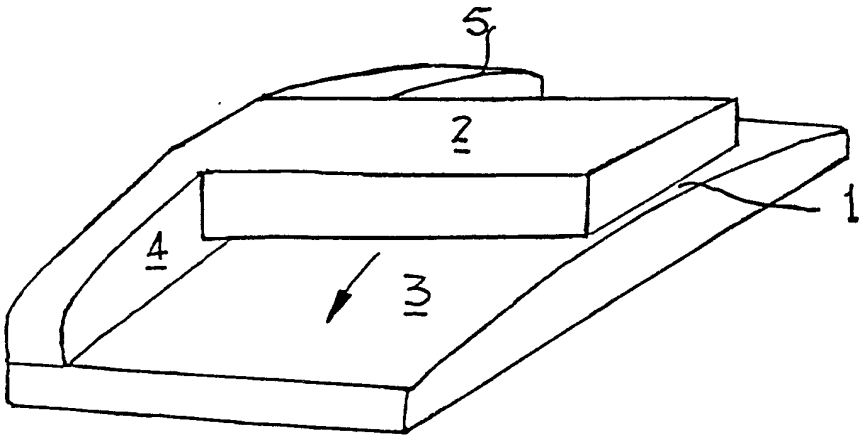


FIG 1

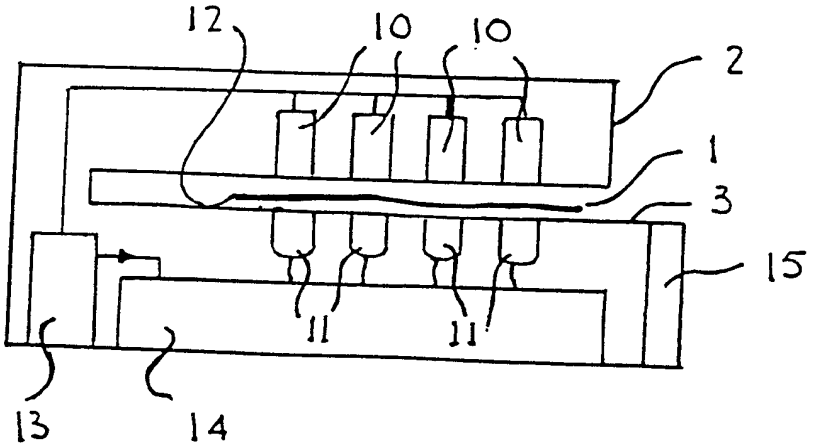


FIG 2

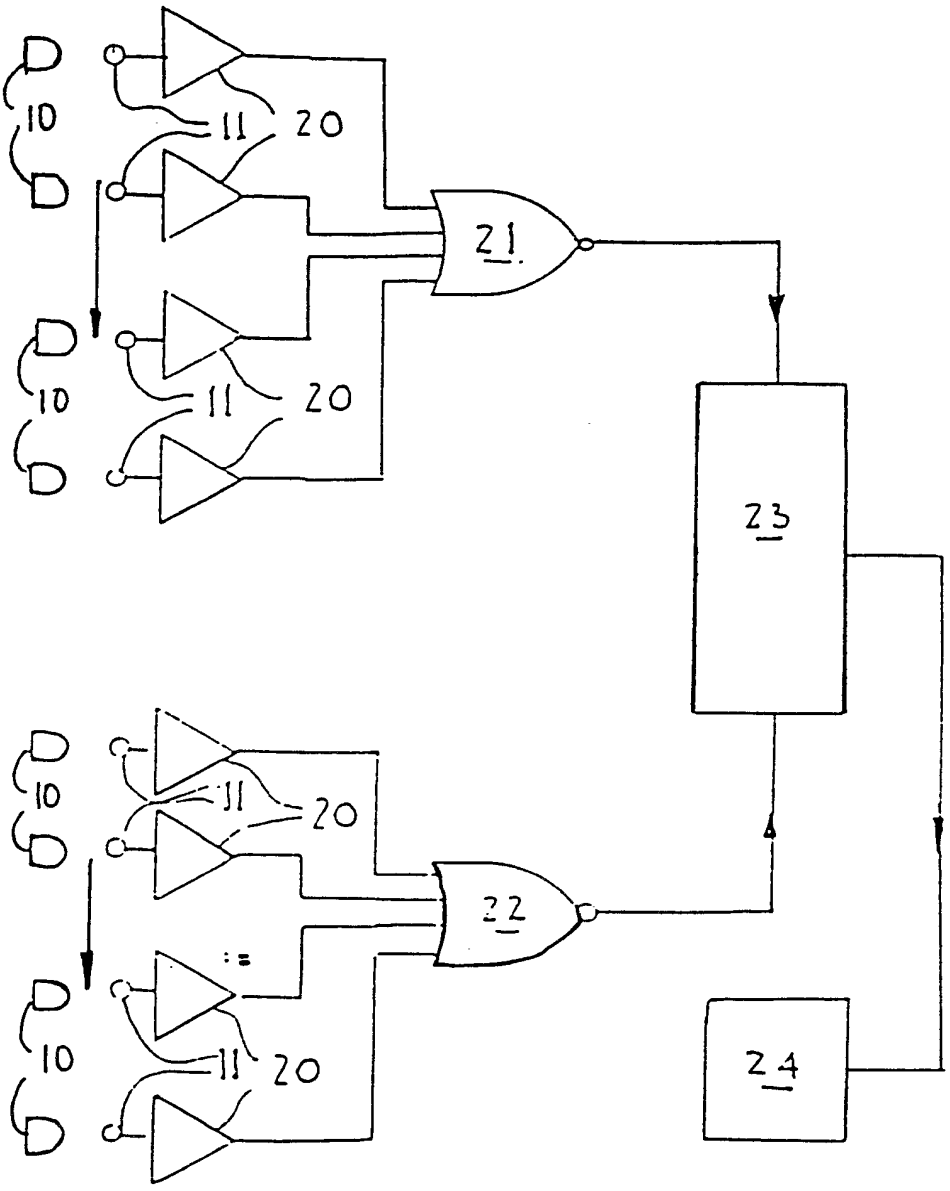


FIG 3

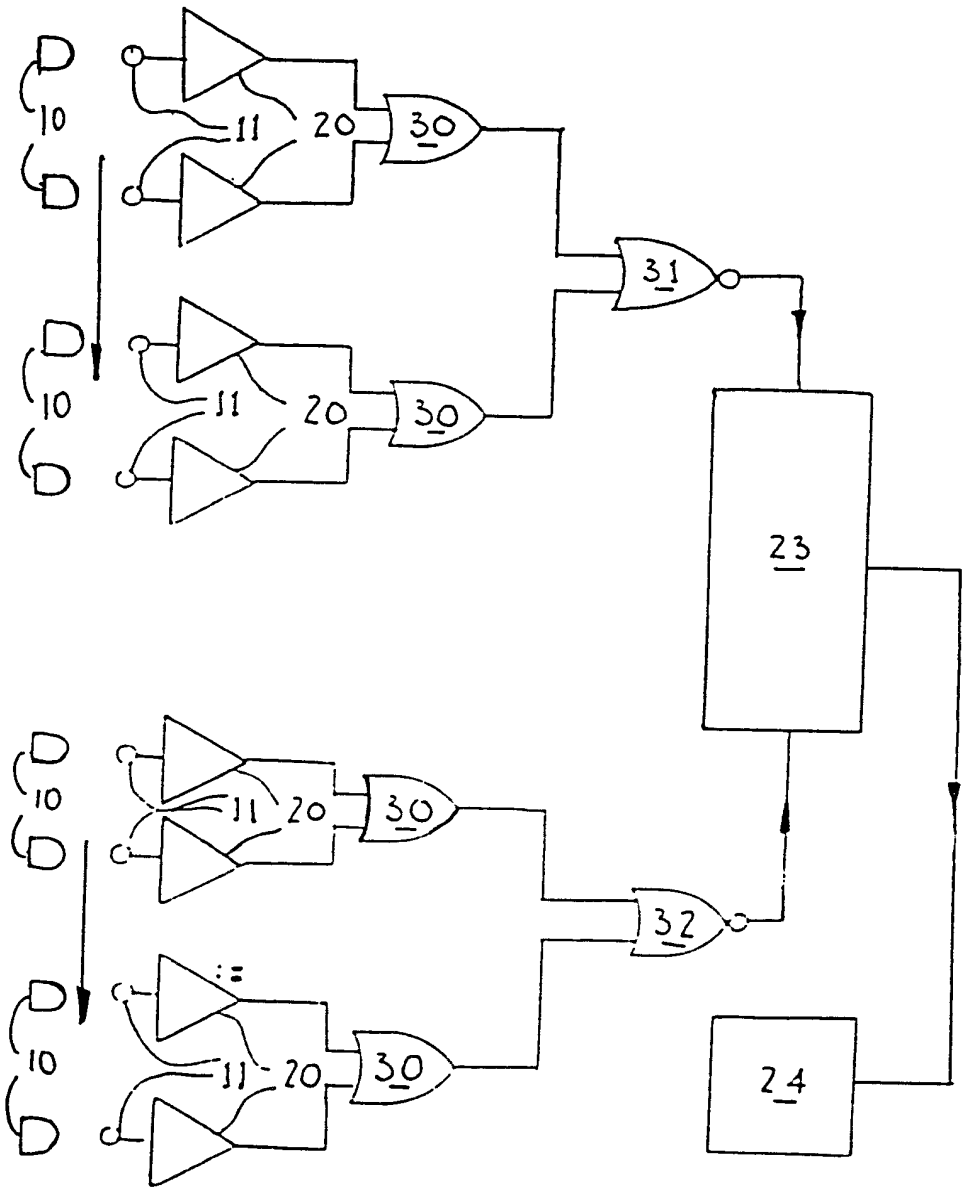


FIG 4

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# SECURITY DEVICE

This invention relates to a security device and more particularly to a device for detecting security strips in banknotes and like articles.

In order to defeat the efforts of counterfeiters and forgers a number of security features are incorporated into banknotes, bonds and other widely circulated documents of high value. Many of these features are ineffective when skilled printers have access to suitable sources of paper with the appropriate composition. Watermarks may be created easily however in recent years a metal security strip has been incorporated in the paper, a feature that is not easily copied. The strip is normally a thin piece of foil, usually silver, which is incorporated within the lamina of the paper used for the note. In recent times the strip has been woven into one lamina of the paper so that portions of the reflective metal surface can be observed.

People who handle banknotes must check each note carefully to ensure that they are not accepting forgeries. The simplest method of checking these notes is to hold them up to the light or place them over a diffuse light source so that the opaque strip is apparent. Such a checking method can sometimes be defeated by printing a dark line on the note. In the case of woven metal strips it is essential to check that the security strip is continuous and does not comprise a series of printed metallic patches. While such checking of banknotes is well within the skill of a young human operator with acute vision the performance of such operators deteriorates with time and age. Visual accuity falls after a few hours on a supermarket till and when inspecting many hundreds of notes a forgery may easily be missed.

The present invention provides a device for detecting security strips which does not rely on the vision of a human operator and which may be used continuously without deterioration of performance.

According to the present invention there is provided a device for detecting security strips in thin transparent or translucent sheets comprising an enclosed scanning chamber adapted to allow the passage of the sheet, one or more rows of infra-red radiation sources and matching rows of associated infra-red radiation detectors spaced from said radiation sources within the scanning chamber, logic means arranged to receive the output signals from each row of detectors and to provide a strip detection signal if at least half of the signals in the or each row are substantially reduced, and indicator means for providing an indication signal in response to the strip detection signal.

In a preferred embodiment two closely spaced parallel rows of infra-red radiation sources and associated infra-red radiation detectors are used. The logic output from each row is fed to a latching circuit with a limited latch duration. If both circuits are latched the coincidence is detected and used to operate the indicator means and to reset the latch circuits. Such an arrangement is responsive to the width of the security strip.

The rows of infra-red (IR) radiation sources may consist of a series of individual infra-red emitting sources, such as light emitting diodes (LEDs), or a single infra-red source, such as a high power LED or an incandescent lamp, whose output is split into a series of discrete sources by suitable optical direction means such as reflectors or radiation conducting fibres. The radiat-

ion sources may emit radiation continuously or be modulated in synchronisation or succesively to provide a scanning effect.

The associated infra-red radiation detectors must inherently, or by optical direction means, be arranged to accept radiation from a single IR source. Preferably the detectors are junction photodetectors with small detection areas such as photodidodes or phototransistors. The response of the IR detectors must be comparatively rapid to ensure that the sheet may be passed rapidly through the scanning chamber.

In a preferred embodiment a row of IR emitting LEDs is located parallel to and spaced from a row of associated IR sensitive photodetectors. The spacing distance and/or the optical shielding between each LED is arranged so that the emitted radiation falls only on the associated phototransistor. The gap between the LED and the phototransistor need only be sufficient to allow the passage of the sheet, such as a bank note, however a cover or other shield transparent to IR radiation is preferred for both the LEDs and the phototransistors to prevent any reduction in sensitivity due to the build up of dust, or other optically dense contaminants, on the sensitive surfaces during use.

The electrical outputs from the IR sensitive phototransistors, or other radiation detectors, are amplified in such a manner that a dichotomous signal is produced providing a logic 1 or 0 according to the presence or absence of radiation. The logic outputs from each row are combined in a logic element that provides an output when at least half the signals are have the same logic value. In a preferred embodiment two rows of LEDs and phototransistor detectors are used preferably consisting of four

pairs of elements in each row. The logic outputs of each set of detectors are combined using NOR or AND gates with the appropriate number of inputs so that a logic 0 or 1, as a strip detection signal, is provided only when the outputs of at least half the detectors in a row are identical. When clean notes are being checked the logic signal may be provided when all the outputs of the detectors in a row are identical. For checking used notes the logic signal at half the outputs are identical proves satisfactory. In an alternative embodiment a different proportion of outputs, e.g. six out of eight, may be used as a signal that the security strip is present.

In a preferred embodiment the sensor outputs are paired and each pair of outputs arranged to supply a logical OR output to an AND circuit so that a strip detection signal is provided when the outputs of all the pairs of detectors are identical. This output will indicate that at least half the detectors have been in a strip detection state.

When two or more rows of detectors are used the logic outputs for each row are compared for identity for a limited time period. If the rows all provide the same logic value during this period then the sheet passing through them contains a security strip. If one row has a different logic value to the others the passage of a security strip will still be indicated provided the time period has not elapsed. Each row may comprise a set of paired detectors, as described above, and the logic outputs considered for identity would be the OR output of each pair.

The signal indicating the presence of a security strip may be an audible one, such as a buzzer or tone generator, or a visible one such as a light indicator. In a

preferred embodiment both forms of indicator are used simultaneously. In order to avoid confusion between successive sheets or banknotes passing through the device the indicator means should operate for a short period, e.g. 50 to 500 milliseconds, determined by a timer whose operation is initiated by the detection signal. In a preferred embodiment the signal last for 100 milliseconds. The transport through the scanning chamber may be manual or assisted by driving means such as a pair of rollers driven by an electric motor.

Electrical power for the device may be provided by batteries contained internally or externally. Alternatively the power may be obtained from a mains electricity supply directly or through an adaptor providing a rectified and stabilised output. In one embodiment the device is powered with rechargeable batteries which are maintained in a charged state by connection to a mains supply. In a preferred embodiment the supply is regulated 5 volts DC, a customary potential for use with TTL, CMOS and similar integrated circuits.

In order that the invention may be clearly understood one embodiment thereof will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a device in accordance with the invention,

Figure 2 is a schematic cross-section of the scanning chamber of a device in accordance with the invention,

Figure 3 is a schematic diagram of one embodiment of a logic system used to detect and signal the absence of an opaque strip, and

Figure 4 is a schematic diagram of an alternative embodiment of a logic system used to detect and signal the absence of an opaque strip.

A device according to the invention consists of a scanning chamber formed, see Figure 1, by a slot 1 located between an upper portion 2 and a lower portion 3. The upper portion 2 is supported in position by side pieces 4 and 5. The portion 2 contains two closely spaced rows of small infra-red radiation sources and the lower portion 3 contains two corresponding rows of photodetectors aligned with the radiation sources, neither row shown. A note is passed into the chamber by directing it into the slot 1 in the direction shown by the arrow.

The cross-section of the scanning chamber, see Figure 2, shows that a series of small beams of infra-red radiation are directed across the slot 1 from two rows of infra-red radiation sources 10 in the upper portion 2 to two corresponding rows of photodetectors 11 located in the lower portion 3. The sources 10 are preferably infra-red emitting LEDs and the detectors preferably phototransistors. The rows of sources 10 and detectors 11 are arranged transversely to the direction of movement of notes 12 passing through the slot 1.

The sources 10 are supplied with electrical power from a supply 13. The outputs of the photodetectors 11 are fed to a logic and control unit 14 which contains a latch circuit for each row. The latches are set if the transmission path from each of the sources 10 to detectors 11 in the associated row are identical and none of them are receiving radiation. When both latches are set their logic status indicates that a security strip or other continuous opaque strip has passed through both rows. This state is detected in the unit 14 which responds by triggering the indication means 15. The means 15 provides an audible and/or visible indication that a strip has passed through the rows. The latches preferably are self-

resetting after a short delay. By this means the device is able to discriminate between opaque strips of different widths when passed through it. The unit 14 includes a timing circuit which limits the duration of the status indication signal. A period of 100 to 200 ms is usually sufficient for both audible and visible signals to be noticed by an operator.

An embodiment of the logic and control unit 14, see Figure 3, consists of a set of differential amplifiers 20 adapted to receive the output of each phototransistor detector 11 at one input and provide a dichotomous output according to whether the intensity of radiation falling on the asociated detector 11 is above or below a certain intensity. The comparison is carried out in known manner by setting an appropriate fixed potential at the complementary input to each amplifier or by feeding the output of each amplifier to a comparator circuit to achieve the desired dichotomous output. The outputs of each set of four amplifiers 20, corresponding to each row of sensors 11, are supplied to four input NOR gates 21 and 22.

Each NOR gate 21 and 22 will give an output when all inputs are logically zero. The outputs from the gates 21 and 22 are supplied to unit 23 which triggers a timer when the both outputs are the same for a limited time period. At the same time an indicator unit 24 responds during the initiated timing period and provides audible and visible warning that a note with an opaque strip has passed through the device.

In an alternative embodiment of the logic and control unit 14, see Figure 4, the same items carry the same reference numerals as described in respect to Figure 3. The unit 14 consists of a set of differential amplifiers 20

adapted to receive the output of each phototransistor detector 11 at one input and provide a dichotomous output in the manner previously described. The outputs from each pair of the amplifiers 20 connected to adjacent photodetectors is supplied to a two input OR gate 30. The outputs of the OR gates 30 will be logic 1 when either or both of the associated photodetectors indicates the presence of a security strip. The outputs of each pair of OR gates 30 is supplied to two input NOR gates 31 and 32. The outputs from the gates 31 and 32 are supplied to the unit 23 which triggers a timer when the both outputs are the same for a limited time period as described previously.

It will be clear that other logic arrangements could be chosen to achieve the necessary status warning system.

CLAIMS

1. A device for detecting security strips in thin transparent or translucent sheets comprising an enclosed scanning chamber adapted to allow the passage of the sheet, one or more rows of infra-red radiation sources and matching rows of associated infra-red radiation detectors spaced from said radiation sources within the scanning chamber, logic means arranged to receive the output signals from each row of detectors and to provide a strip detection signal if at least half of the signals in the or each row are substantially reduced, and indicator means for providing an indication signal in response to the strip detection signal.

2. The device according to claim 1 in which two closely spaced parallel rows of infra-red radiation sources and associated infra-red radiation detectors are used.

3. The device according to either claim 1 or claim 2 in which the logic output from each row is fed to a latching circuit with a limited latch duration.

4. The device according to claim 3 in which simultaneous latching of the latching circuits is detected and used to operate the indicator means and to reset the latch circuits.

5. The device according to any of the preceding claims, in which the rows of infra-red radiation sources are a row of individual infra-red emitting sources.

6. The device according to claim 5 in which the infra-red emitting sources are light emitting diodes.

7. The device according to claim 6 in which one or more rows of infra-red emitting light emitting diodes are located parallel to and spaced from one or more rows of associated infra-red radiation detectors.

8. The device according to claim 7 in which two rows of light emitting diodes with matching rows of infra-red radiation detectors are used consisting of four pairs of elements in each row.

9. The device according to claim 5 in which the infra-red emitting sources are formed from a single infra-red source, whose output is split into a series of discrete sources by suitable optical direction means such as reflectors or radiation conducting fibres.

10. The device according to claim 9 in which the infra-red emitting source is a high power light emitting diode.

11. The device according to claim 9 in which the infra-red emitting source is an incandescent lamp.

12. The device according to any of the preceding claims, in which the infra-red radiation sources emit radiation continuously.

13. The device according to any of the claims 1 to 11, in which the infra-red radiation sources are modulated, in synchronisation or succesively, to provide a scanning effect.

14. The device according to any of the preceding claims, in which the electrical output from each of the infra-red radiation detectors is amplified in such a manner that a dichotomous signal is produced providing a logic 1 or 0

according to the level of radiation received and in which the logic outputs from each row are combined in a logic element that provides a strip detection signal when at least half the signals have the same logic value.

15. The device according to claim 14 in which dichotomous output signals in each row are paired and each pair of outputs arranged to supply a logical OR output to the logic element so that a strip detection signal is provided when the outputs of all the pairs of detectors are identical.

16. The device according to any of the preceding claims, in which the indication signal denoting the absence of a security strip operates for a period in the range 50 to 500 milliseconds determined by a timer whose operation is initiated by the signal.

17. Devices for detecting security strips according to claim 1 and as herein described.

18. Devices for detecting security strips as herein described and illustrated in the accompanying drawings.

**Patents Act 1977**
**Examiner's report to the Comptroller under Section 17**
**(The Search report)**

Application number
GB 9324446.5

**Relevant Technical Fields**

(i) UK Cl (Ed.M) G1A (AMBP, AMK, AMZ)

(ii) Int Cl (Ed.5) G07D

Search Examiner
S J MORGAN

Date of completion of Search
25 JANUARY 1994

**Databases** (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-16

**Categories of documents**

**X:** Document indicating lack of novelty or of inventive step.

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**A:** Document indicating technological background and/or state of the art.

**P:** Document published on or after the declared priority date but before the filing date of the present application.

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**&:** Member of the same patent family; corresponding document.

| Category | Identity of document and relevant passages | | Relevant to claim(s) |
|---|---|---|---|
| X,Y | GB 1579390 | (FORECOURT) - see whole document | X: 1,2,5-7, 12,14<br>Y: 1,2,4,5, 6 |
| Y | EP 0537513 A1 | (URMET) - see whole document | Y: 1,2,5,6 |
| Y | US 4524276 | (TOKYO SHIBAURA) - see for example lines 48-66, column 4 | Y: 4 |

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DERWENT-ACC-NO: 1994-170327

DERWENT-WEEK: 199421



TITLE: Security strip detection appts for banknote testing passes note between rows of infrared radiation sources and infra-red radiation detectors whose output is fed to logic element

PATENT-ASSIGNEE: HENLEY C S[HENLI] , VANDENBERG M E[VANDI]

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PATENT-FAMILY:

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|---|---|---|
| GB 2273353 A | June 15, 1994 | EN |

APPLICATION-DATA:

| PUB-NO | APPL-DESCRIPTOR | APPL-NO | APPL-DATE |
|---|---|---|---|
| GB 2273353A | N/A | 1993GB-024446 | November 29, 1993 |

INT-CL-CURRENT:

| TYPE | IPC DATE |
|---|---|
| CIPS | G07D7/00 20060101 |
| CIPS | G07D7/12 20060101 |

ABSTRACTED-PUB-NO: GB 2273353 A

BASIC-ABSTRACT:

The device comprises an enclosed chamber (1) allowing the passage of a bank note. The note passes between rows of infrared radiation sources (10) and radiation detectors (11). The output signal from each detector depends on the presence of an infra-red opaque object. The detector output signals are monitored and a strip detection signal is provided if half or more of the signals in a row are reduced. The strip detection signal initiates an audible warning and/or illumination of an indicator light.

ADVANTAGE - Does not rely on vision of human operator.

CHOSEN-DRAWING: Dwg.2/4

TITLE-TERMS: SECURE STRIP DETECT APPARATUS BANKNOTE TEST PASS NOTE ROW INFRARED RADIATE SOURCE INFRA RED OUTPUT FEED LOGIC ELEMENT

DERWENT-CLASS: T05

EPI-CODES: T05-J;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: 1994-134164